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KRISTOFER POLHEM



ENTURIES ago, while the Swedes made their living by hunting and fishing, there was little if any knowledge of the various mechanical trades, and no need was felt in this direction; but when the people began to till the soil and build large houses, there arose

a demand for more perfect tools than the simple hunting and fishing implements and for more power than the arm could furnish. It then became necessary to construct water-motors for driving flour-mills, etc., and various devices such as levers, hoists, etc., whereby human labor is saved. But such appliances were for a long period of time of very primitive nature, and the art of constructing them, or mechanical science, was hardly known by anybody before the time of Polhem, whose biography and most important inventions will be briefly treated.

Kristofer Pålhammar (afterwards named Polhem) was born in Visby, 1661 A. D. His father, Wulf Kristofer Pålhammar, was a merchant at the same place. His mother was Kristina Schening, from Vadstena. His father died when Kristofer was only a child—the oldest of three boys. His mother, though poor, kept her boys in the school at Visby; but when she married the second time, his stepfather thought he could not afford to keep Kristofer longer in school. An uncle, who was clerk at the post-office in Stockholm, took care

of him and let him attend the so-called German counting school; but his benefactor died soon, and then Kristofer. only twelve years old, was obliged to earn his own living. He was employed by a Lady Björnklou as clerk at her Kungshamns estate near Upsala, and later had a better position at her estate Vansta in Osmo parish, Södermanland. Kristofer was in this lady's employ for twelve years. During this time he developed more and more his talent for mechanics. He succeeded after a long struggle in completing a shop for carpentering, wood-turning and blacksmithing, where he perfected his inventions by means of tools which he made himself. He put together with great skill many kinds of machines, such as clocks, mechanical steak turners, etc., which were admired by all who saw them. People who learned of his extraordinary talents felt pity for him because he had not studied more, otherwise he could have accomplished still greater things. Palhammar realized himself how deficient he was in learning, and intended to go to Strengnas for a course of study; but Lady Björnklou, who did not want to have Palhammar leave her, said that at the age of twenty-three years he was too old to go to school, and persuaded him, partly by promises, partly by polite command, to stay in her service for a few years longer.

Then it happened that a surveyor came to the farm to measure it, and Pålhammar got a chance to watch his methods, which were new to him. He followed the engineer in his work and could soon do all that he did. But he had sense enough to realize that he still needed to know the fundamental truths of science. He heard of books in the Latin language, which contained the fundamentals of mechanics; and so he wished most of all to learn Latin. He sought advice from a priest among his acquaintances, who gave him a dictionary in Latin and Swedish, and Pålhammar began to learn it by heart. He soon found out that this was not the right way to

study, but he knew no better way. Then there came to Vansta another priest, Lars Welt, who was a private tutor at Follnäs in Sorunda parish. He wanted Pålhammar to make him a clock. Pålhammar told him all his plans and troubles and offered to make a clock which would strike full, half and quarter hours, show day in the week and month, full moon and new moon, if he would only teach him Latin. Welt accepted the proposition willingly, gave Pålhammar other books, and showed him how to use them. He came once a month to Vansta to give his pupil new lessons.

Pålhammar soon left Vansta and found work in Follnäs, where he could be nearer his teacher; but the priest left in a few months, and the one who took his place also left after a short time. Then Pålhammar turned to the learned Father Erland Dryselius at Sorunda, who devoted much attention to teaching Pålhammar. The greatest obstacle in the way, in the opinion of Father Dryselius, was the distance—about five English miles—between Sorunda and Follnäs; but this did not frighten Pålhammar. During seven months' time he walked this distance back and forth, often in stormy weather and often without finding his teacher at home.

When Palhammar, by persistent effort, had prepared himself, he went to the High School at Upsala, carrying with him a letter of introduction from Father Dryselius to the professor in mathematics, Anders Spole. He soon gained his new teacher's friendship, especially so after he had repaired two clockworks belonging to Spole's astronomical apparatus.

After two years' hard study something occurred, which Palhammar often referred to as being especially sent by Providence, to make him better known and which laid the foundation for his success in the world. Between two columns behind the altar in the cathedral at Upsala stood a very complicated clock, which no

mechanic for more than one hundred years had ventured to start going, still less to repair. This clock was made by a monk at Vadstena cloister. It showed not only days and hours, but also new moon and full moon and new year. But a large part of this clock was not completed, and other parts were so poorly designed that much needed to be changed and added. Palhammar undertook to fix and reconstruct the clock, which took him two years and which, in every particular, he did with his own hands. Formerly the clock had to be wound up once a day, but Palhammar introduced a pendulum movement and arranged it so that it could run six weeks before rewinding. The hands were to be turned by an attendant, some once a day, some once in a few days; but Palhammar invented a way of connecting them with the main driving mechanism so that all hands were moved by the same power, automatically. This mechanical wonder, which became widely known and admired even by foreigners, was destroyed by fire in 1702.

Encouraged by his success, Palhammar now turned his attention to mine machinery. His sharp eyes had already detected their imperfections. He exhibited before the College of Mining Engineering a model of his first invention to facilitate mining. It consisted of a hoisting apparatus, in several respects superior to the one then in common use, but at the same time as simple as it was effective and adapted to perform a multitude of operations. One and the same machine carried the ore from the shaft where it was cut to the opening, and from there to the blast furnace, where the barrels or buckets were emptied automatically by the opening of the bottom. Then the bottom closed itself and the bucket traveled back for more ore, and all this without a human finger toughing any part of the mechanism. The whole consisted mainly of two pairs of wooden bars which moved up and down and which in a simple way hooked onto the bucket. No ropes were used, being at that

time of poor quality.

King Charles XI, to whom this invention was shown, was so well pleased with it that he gave Pålhammar the title of Mining Engineer (bergsmekanikus), a position which gave him a salary of 500 crowns. The King gave him an order to apply his invention at the mines at Falun, which he did with perfect success and great economy. Similar machines were afterwards built for other mines and were more and more improved by the inventor.

Palhammar now went abroad to Holland, England and France to study mechanical works. People took notice of the ingenious Swede wherever he went. He learned, on his arrival in Paris, that several mathematicians there had tried to make a clock which would show the ways of counting the time by the various peoples on the earth and at the same time strike the hours, but had abandoned the work on account of its difficulties. Palhammar sent, through the Swedish consul in Paris, a notice that he was willing to carry out the idea, and he soon had a model made which demonstrated that the problem was solved. This model was reproduced in Paris in an elegant way at an extraordinary cost and presented to the Sultan of Turkey. A description of the invention was also written in German in which Palhammar was credited as the origi-

Having returned to Sweden after three years' absence, Palhammar devoted his time and talent in carrying out what he had learned abroad. Among his more noted enterprises was the building of what is called "stanggangar," by which power from a waterfall is transmitted for a long distance. The idea was not entirely new, but Palhammar was the first to proportion the parts correctly, and on this depended the success of the whole. This excellent mechanism is still used at

Falun, Hunnebo, Bispberg, etc. Especially at Bispberg it is remarkable to see a long line of bars nearly two miles long, moving back and forth, transmitting the power from the river at Säter to the mines, and transporting the ore without noticeable loss of power. Another famous undertaking in which Palhammar had a part was the building of the ship-dock at Carlskrona. The English shipbuilder, Sheldon, had proposed this expensive dock, but it was only after he had consulted Palhammar that the plans were submitted to King Charles XII. To Palhammar came the building of the most difficult part, namely, the dam. It was to be in the shape of a semi-circle and about 70 feet wide by 24 feet deep. Palhammar examined the bottom and completed the dam above the water with the underside shaped to fit the bottom, and then the whole thing was let down and found to fit without much adjustment. This was the only part Palhammar had in building the dock. After this Palhammar received the title of "kommersrad," was made a knight, and changed his name to Polhem.

Another great scheme began at this time to be taken into serious consideration, namely, the great canal through the middle part of Sweden. It was first proposed as early as the reign of King Gustavus I in the XVI century and was not completed until our time. King Charles XII made a contract with Polhem to build the canal in five years. Polhem started at once blasting and excavating, at Trollhättan. Everything was ready for building the locks when one day a mass of lumber and stones was thrown into the river above the dam by men who disliked the enterprise. In this way all of Polhem's plans and labor were destroyed and the work was stopped on account of lack of money in the national treasury. Polhem's drawings and specifications were, however, later used in completing the locks at Trollhättan.

Before the time of Polhem, hardly any works of art and manufacture existed in Sweden; everything in this line had to be brought from abroad. The fact that Sweden was more generously supplied with metal, such as iron and copper, and of better quality than many other countries, ought to have been sufficient reason for developing metal industries. Polhem was annoyed by this condition of affairs and determined to make a start in manufacturing. He joined the owner of the ironworks at Stjernsund, and founded the well-known works for the manufacture of iron, steel, copper and brass. There were also built rolling mills for plates and hoop iron and shears, presses, files, screw and lock machines, etc. There was also to be seen a machine driven by water power for making parts of a watch, almost automatic in its action. Another machine made dishes, bowls, etc., of sheet iron. Eighteen hammers were used for this work and all were driven by one water-wheel, but could be used either together or separately.

Polhem also contributed largely towards the development of woolen manufactures, as, e. g., a loom for stitching stockings, wash-tub for wool and yarn, and several other appliances. The farmer has also been benefited by Polhem's genius. The sowing-machine, the plow, the harrow, the threshing-machine, improved wind-mills and water-motors, etc., are all the fruit of his fertile brain.

On account of so many and important inventions and improvements, Polhem's name soon became famous abroad. King George Leopold of Hanover invited Polhem to Harzbergen, where he owned large mines, and here Polhem made many improvements. King George Leopold afterwards sent year after year young Germans to Sweden to study under Polhem's direction and to learn about his inventions. Even after George Leopold had become King of England, he kept himself well informed about this Swedish mechanic and his work.



Czar Peter I, of Russia, tried to persuade Polhem t work for him, but the patriotic Swede would not leav his native land; and the King did not forget to bestor honor on the man who was the pride of Sweden.

Polhem was of fine, tall physique. His face, thoug with sharp features and a serious expression, wa pleasant. He enjoyed good health in youth and middl age, but was later troubled with sickness. His min remained vigorous during his whole life until the last He died 1751, in Stockholm, at the age of ninety.

Translated from the Swedish by George Steurin

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